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GB 1588107 A EP 0812033 A2 EP 0634882 A2

(58) Field of Search
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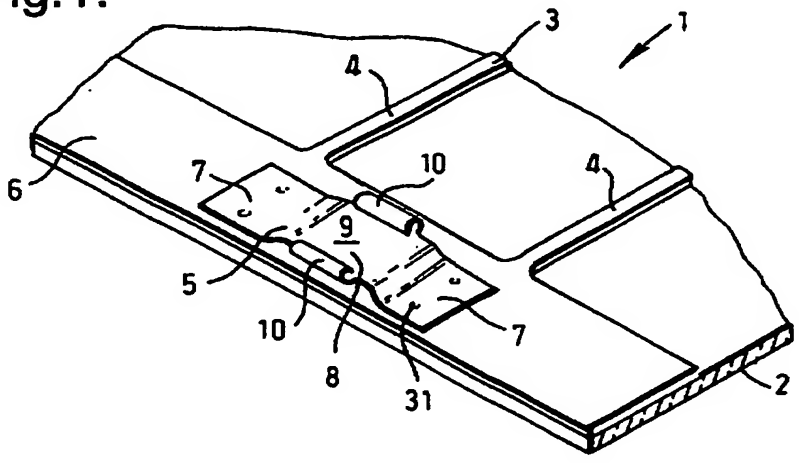
(54) Abstract Title
An electrical terminal for a window

(57) An electrical terminal 5, 20 is provided for a window 1 including an electric circuit 3, the terminal comprising at least one foot 7 for soldering to an electrically conducting substrate 6 on a sheet of glass 2, wherein the terminal is provided with a female connector element 9. The terminal may comprise two spaced coplanar feet for soldering, and a bridging portion 8, 23 connecting the two feet and including the female connector element. A corresponding male connector element 40 provided with a removable or retractable insulating casing 50, 60, 70, 80 is also described. The window may be for an automotive vehicle; in such windows the connection between terminal and window is subject to damage from thermal or mechanical stresses.

Fig.1.



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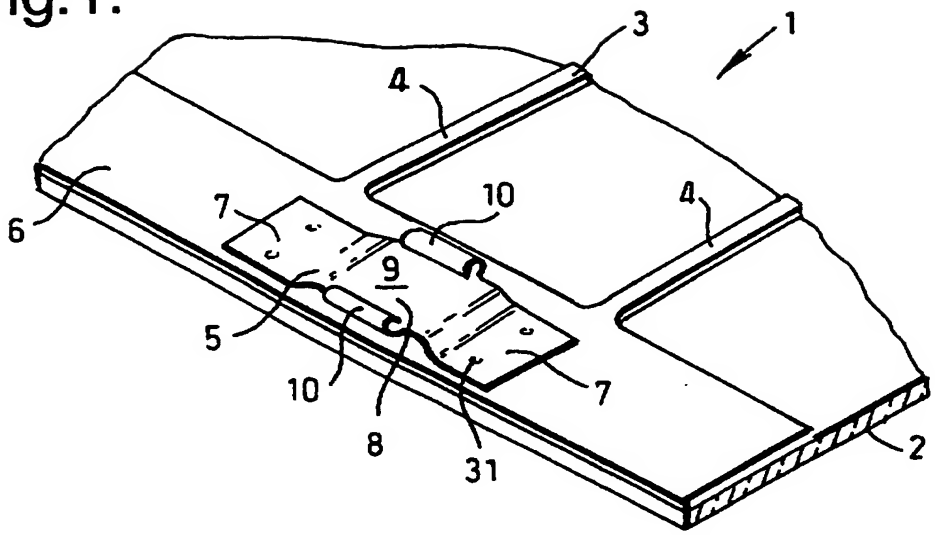
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1.



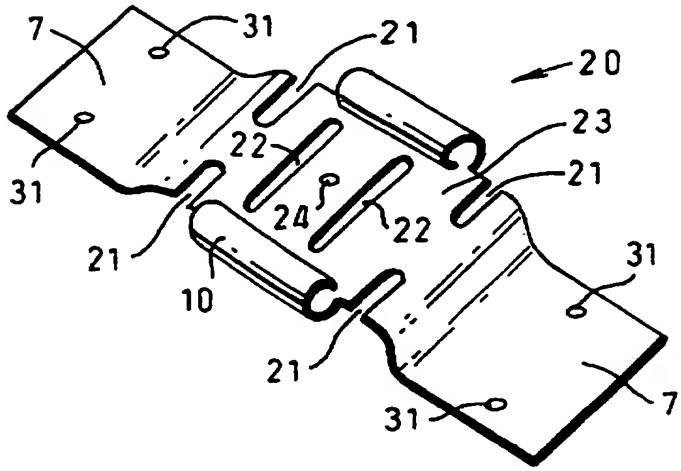


Fig.2.

Fig.3.

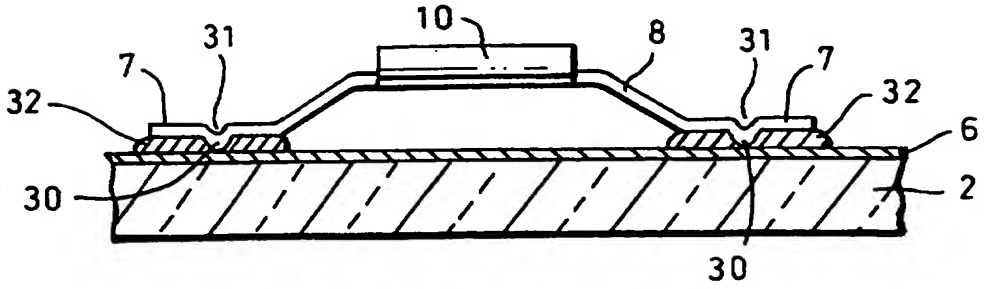


Fig.4.

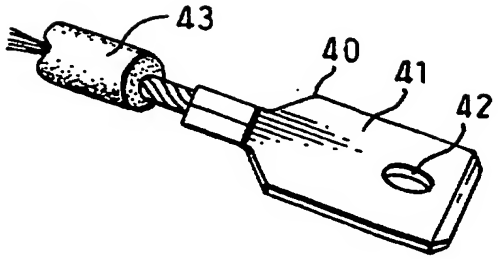


Fig.5.

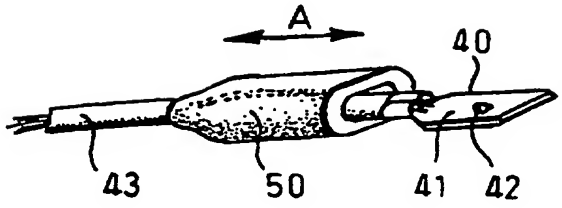


Fig.6.

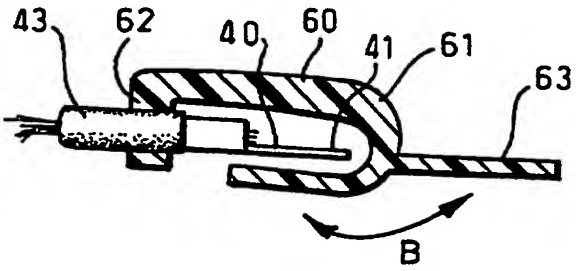


Fig.7.

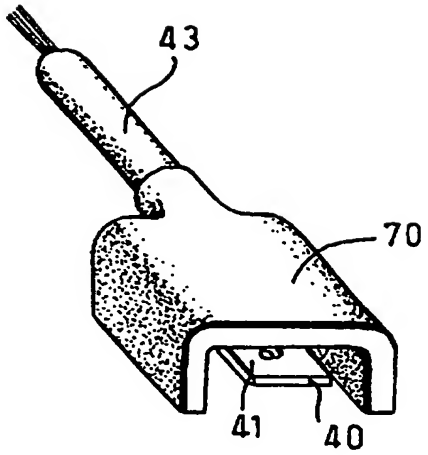
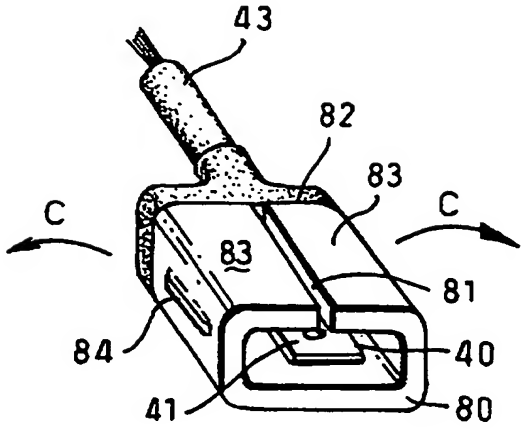


Fig.8.



An Electrical Terminal for a Window

The present invention relates to an electrical terminal for a window provided with an electric circuit, especially an electric heating element. In particular, the terminal is suitable for attaching to an electrically conducting substrate provided on an electrically heated window. This substrate may be connected to, or part of, the heating element, and the terminal allows electrical connection to be made to the substrate.

Such terminals are subjected to a variety of stresses from the moment when they are attached onto a window. Attachment is normally achieved by soldering, and thermally induced stresses may result from the act of soldering itself. During the soldering operation, the terminal not unexpectedly becomes hot, whereas the temperature of the glass substrate rises very little. Furthermore, the terminal and glass possess differing coefficients of thermal expansion. Consequently, as the terminal cools, it contracts to a greater degree than the glass, causing a stress to develop.

Further stresses may arise when the window is installed. Heated windows are employed especially in vehicles, and after installation of the window in a vehicle, it is generally necessary to make an electrical connection from the vehicle's wiring harness to the heating element on the window via the aforementioned connector. This operation may involve subjecting the terminal to a degree of stress, and after completing the connection, it is possible that stresses are exerted on the terminal via the lead of the wiring harness.

US 4,023,008 discloses a terminal connection comprising two feet soldered to a conductive coating. The feet are joined by a bridge portion which may be notched, slotted or perforated. The intention is to reduce thermally induced stresses.

However, this design does little to reduce the mechanical stresses which the terminal connection is subjected to. In this context it should be noted that the connection tab 7 in US 4,023,008 extends for quite some distance laterally from the bridge portion of the terminal connection. Consequently, if, as the female or socket part of the connector is pushed onto the tab 7, the pushing force is inadvertently misdirected, then any component of the force which is at right angles to the plane of the tab 7 will result in a significant bending moment being exerted on the terminal connection. The length of tab 7 in effect acts as a lever by which either the terminal connection itself, or the bond to the substrate, or both, may be inadvertently damaged by clumsy fitting of the female connector element. With some

designs of terminal, it is actually necessary for the assembly worker to bend the tab into position before the female connector element can be attached. This operation is frequently a cause of damage.

Unfortunately, it is not possible to alleviate this problem simply by reducing the length of the tab; for an excessively short tab reduces the security of the electrical connection. It would therefore be desirable to provide an improved terminal which may be subjected to the mechanical stresses typical of vehicle assembly operations, with a substantially reduced incidence of damage, especially to the sheet of glass and the conducting substrate to which the terminal is bonded.

It has now been realised that such an improved terminal may be achieved by providing the female connector component on the terminal itself (as opposed to the long-established practice of providing it on the lead to be connected to the terminal). Certain complications arise in the insulation of a male connector component attached to a potentially live supply lead, which the inventor has also addressed in order to provide a practical connector system.

Accordingly, the present invention provides an electrical terminal for a window including an electric circuit, the terminal comprising at least one foot for soldering to an electrically conducting substrate on a sheet of glass, wherein the terminal is provided with a female connector element.

In a preferred embodiment, the terminal comprises two spaced coplanar feet for soldering to the substrate, and a bridging portion connecting the two feet, wherein the bridging portion rises out of the plane of the feet and includes the female connector element.

Suitably, the female connector element is adapted to receive a corresponding male connector element, and the direction of insertion of the male connector element is substantially parallel to a line joining the two feet. In this arrangement, the force employed to insert the male connector is exerted in a direction parallel to the line joining the two feet, resulting in a generally tensile force being exerted on one foot, and a generally compressive force being exerted on the other foot. Such an arrangement is less likely to damage the bond between the feet and the substrate, as it minimises shear forces acting on the feet.

The invention also comprehends a combination of an electrical terminal as described herein and a corresponding male connector element, wherein the male connector element is provided with an insulating casing which allows it to be inserted in the female connector element and make electrical contact therewith, but prevents the inadvertent making of unwanted electrical contact when the male connector element is not so inserted. This avoids

one of the principal obstacles to reversing the accepted arrangement of providing the male connector element on the terminal which is attached to the glass, namely that there would be a danger of a short circuit if the standard uninsulated male "spade" connector were provided on a live cable, e.g. in a vehicle wiring harness.

It is difficult to insulate a male connector element in such a way that still allows the male to be inserted in the female connector element. However, according to this aspect of the invention, the insulating casing provided on the male connector element may be removable, retractable, or deformable to allow the male connector element to be inserted in the female connector element.

The invention further comprehends a window provided with an electrical circuit, especially an electrically heated window, with an electrical terminal as herein described attached to it.

The invention will now be further described by way of the following specific embodiments, which are given by way of illustration and not limitation, and with reference to the accompanying drawings in which:-

Fig 1 is a perspective view of part of an electrically heated window provided with an electrical terminal according to the invention;

Fig 2 is an enlarged perspective view of an alternative embodiment of electrical terminal;

Fig 3 is a side view, largely in cross-section, of the terminal and window of Fig 1;

Fig 4 is a perspective view of a male connector element suitable for use with an electrical terminal according to the invention;

Fig 5 is a perspective view of an alternative male connector element, provided with a retractable insulating casing;

Fig 6 is a cross-sectional view of a further alternative male connector element, provided with an insulating casing which may be deformed to allow insertion into the female connector element;

Fig 7 is a perspective view of another male connector element having a different design of insulating casing;

Fig 8 is a perspective view of yet another male connector element provided with an insulating casing which again may be deformed to allow insertion into the female connector element.

Referring to Figure 1, there is shown part of a window 1 comprising a sheet of glass 2, and having an electric circuit in the form of a heating element 3. The heating element comprises lines 4 of conductive ink printed onto the sheet of glass. Such heating elements are well known in the art, being in common use on the rear windows of cars, and need not be described further.

An electrical terminal 5 is attached to an electrically conducting substrate 6, which in this embodiment serves as a busbar connecting the heating lines 4, and is preferably printed onto the glass at the same time, and employing the same ink, as heating lines 4. Although shown at the edge of the glass sheet, the busbar may also be positioned inboard of the edge. Also, an opaque band of ink (not shown) may be printed on the glass before the busbar is printed, so as to obscure the busbar from external view when the window is installed in a vehicle. The face of the window shown uppermost in Fig 1 would then face the interior of the vehicle.

The electrical terminal 5 comprises two spaced coplanar feet 7, by means of which the terminal is soldered to the substrate. A bridging portion 8 spans the two feet, and rises up out of the plane of the feet. According to the invention, the terminal includes a female connector element 9, which in these embodiments is formed as part of the bridging portion and is integral with it. The terminal is made from sheet metal, and the metal of the bridging portion is shaped to form the female connector element. More precisely, the edges of the bridging portion are bent towards each other so as to roll up the metal to produce a partial cylinder 10 along each edge. Each partial cylinder remains open along its inward side in order to receive an edge of a male connector.

The electrical terminal 5 is preferably made by stamping blanks from sheet metal, with a subsequent bending operation to form the bridging portion and the partial cylinders. A preferred metal is copper, and it is particularly preferred to plate the terminals with nickel or tin to improve the quality of soldered joint obtained. One of the advantages of the invention is that it is not necessary to use such thick sheet metal for the female connector element as for the male connector element, and hence the whole terminal can be made from thinner sheet. Whereas metal thicknesses of 0.8 mm to 1.5 mm are typical for a male connector element of the flat blade or "spade" variety, the terminal may be manufactured in metal of 0.5 mm or 0.4 mm thickness. Use of thinner metal makes it less likely for any forces exerted on the female connector element to be transmitted to the feet and in particular to the soldered joints.

Instead, the forces are absorbed by flexing or even deformation of the bridging portion of the terminal.

Figure 2 shows an alternative form of electrical terminal 20 which is adapted to receive a male connector element. This terminal differs from that of Figure 1 in that a number of notches 21 and perforations 22 are cut in the metal of the bridging portion 23. These serve to further reduce the stiffness of the bridging portion 23 of the terminal, and thereby increase its compliance. Preferably the perforations 22 are in the form of transverse slots, which together with a small protuberance 24 act in known fashion as a retention mechanism for the male connector element when fully inserted, the protuberance 24 engaging in a corresponding dimple or hole in the male connector.

The terminals of Figures 1 and 2 each have two axes of mirror symmetry; one extending in the direction of elongation of the terminal so as to bisect it, and the other extending at right angles to the first, through the centre of the bridging portion, again so as to bisect the terminal. Generally, symmetrical terminals are preferred because vehicles, and hence vehicle windows, are generally symmetrical. It would be inconvenient to have different terminals for the left and right sides of a window, and there would be the possibility of attaching the wrong terminal for a particular position.

It will be observed that with these two designs of terminal, the male connector element is inserted in a direction substantially parallel to a line joining the mutually closest parts of the two feet, i.e. parallel to the first axis of mirror symmetry described above. Although it is possible to contemplate designs of terminal within the scope of the invention which lack any mirror symmetry, or indeed any symmetry at all, the direction of insertion of the male connector element is still parallel to a line joining the two feet in the sense of joining their mutually closest parts. This is advantageous in comparison with known terminals carrying a male connector element, because in the latter it is generally necessary to attach the female connector by pushing it onto the male in a direction generally at right angles to a line joining the two feet, and this operation may subject the soldered joints to a high degree of shear. Furthermore, this direction of attachment results in the male connector element and lead extending parallel to and in line with the busbar. This gives a neater appearance, as the male connector element is then hidden from external view by the busbar.

Figure 3 shows a side view, largely in cross section, of the terminal of Figure 1. It can be seen that the feet 7 of the terminal are provided with protuberances 30 in the form of small bumps which protrude from the surface of the foot to be soldered to the substrate. These are

generally formed by pressing from the opposite side, so the opposite side (which is the upper surface in the drawings) generally displays corresponding dimples 31. The purpose of the protuberances is to space the feet 7 from the substrate 6, thereby ensuring space for a layer of solder 32. This has been found to enable a stronger joint to be achieved; without the protuberances, pressure applied to the feet 7 during soldering may cause the majority of the solder to be squeezed out.

Figure 4 illustrates a conventional male connector element 40 in the form of a flat blade, generally known as a "spade" connector. The blade 41 of the connector includes a perforation or dimple 42 which co-operates with the protuberance 24 on the female connector element to assist in retention of the male, as described in connection with Figure 2. The connector is crimped onto a lead 43, which may be part of a vehicle wiring harness. As mentioned earlier, when an uninsulated connector of this type is affixed to a potentially live lead, a danger of a short circuit arises. Figures 5 to 8 show various forms of insulating casing which allow the male connector element to be inserted in the female connector element and make electrical contact therewith, but prevent the inadvertent making of unwanted electrical contact when the male connector element is not so inserted.

Figure 5 shows the male connector element 40 fitted with an insulating casing in the form of a retractable sheath 50. The sheath slides on the lead 43 in either of the directions indicated by arrow A. The sheath is shown retracted, as it is when the male connector element is inserted in the female. Should the male connector element need to be removed from the female for any reason, the sheath is slid over the blade 42 of the male connector element to insulate it.

Figure 6 illustrates the male connector element 40 fitted with an insulating casing 60 which is deformed to allow insertion of the male into the female. The casing comprises a resilient plastics strip 61 which is formed so that its shape in cross-section is that of a letter U. The base 62 of the casing encircles the lead 43 thereby securely attaching the casing, and the strip curls around the blade 41 of the connector element to insulate it. To insert the male connector element into the female, the insulating strip 61 is bent back in the direction of arrow B to reveal the blade 41 of the male. To facilitate bending the strip 61 back, a tab 63 may optionally be provided. Should the male connector need to be removed from the female, the inherent resilience of the plastics material from which the insulating casing is made causes the strip 61 to return to the U-shape in which it was formed.

Figure 7 shows the male connector element fitted with a very simple design of insulating casing 70 which allows the male to be inserted in the female without the need for the casing to be removed, retracted or deformed. The casing 70 is in the form of a sheath with one side cut away, and is wide enough to accommodate the partial cylinders 10 of the female connector element. The principal drawback of the design is that, as the blade 41 of the connector is not totally enclosed, the casing only prevents unwanted electrical contact of the male connector element with flat conductive surfaces.

Finally, Figure 8 illustrates a male connector element fitted with an insulating casing 80 which is again deformed to allow the male to be inserted into the female. The design is shown upside down for clarity, and is based on a sheath which is internally wide and deep enough in the region of the blade 41 of the male connector element to enclose also the female connector element. In particular, the casing is again wide enough to accommodate the partial cylinders 10 of the female. To allow the underside of the casing to be bent out of the way prior to insertion of the connector, longitudinal and transverse cuts 81, 82 are provided in the casing. Accordingly, the underside of the casing may be bent back in the direction of arrows C in the form of two wings 83. To assist with this, and in particular to open up the longitudinal cut 81, ridges 84 may be provided along the sides of the casing. Preferably the casing is formed in a resilient plastics material, so that the wings 83 tend to return to their original position after insertion, i.e. they tend to fold under the female connector element in the space between it and the substrate 6. Alternatively, the wings may be tucked into this space manually.

Thus it will be appreciated that for the first time a practical connector system for a window has been provided in which the female connector element is part of the terminal attached to the glass. This connector system is particularly suitable for electrically heated rear windows of vehicles. Given the considerable amount of processing that is involved in the manufacture of such windows, it is especially wasteful when a complete window is rejected because of damage caused via a prior art terminal. Use of the present invention could result in considerable reductions in the level of such rejection.

Claims

1. An electrical terminal for a window including an electric circuit, the terminal comprising at least one foot for soldering to an electrically conducting substrate on a sheet of glass, wherein the terminal is provided with a female connector element.

2. An electrical terminal as claimed in claim 1, comprising two spaced coplanar feet for soldering, and a bridging portion connecting the two feet, wherein the bridging portion rises out of the plane of the feet and includes the female connector element.

3. An electrical terminal as claimed in claim 2, wherein the female connector element is adapted to receive a corresponding male connector element, and the direction of insertion of the male connector element is substantially parallel to a line joining the two feet.

4. An electrical terminal as claimed in any preceding claim, wherein the female connector element is formed by bending the edges of the bridging portion towards each other to produce a partial cylinder along each edge, each partial cylinder remaining open along its inward side so as to receive an edge of a male connector element.

5. An electrical terminal as claimed in any preceding claim, wherein the terminal is made from sheet metal with a thickness of 0.5 mm or less.

6. An electrical terminal as claimed in claim 2, wherein the bridging portion has slots, notches or perforations to reduce its stiffness.

7. An electrical terminal as claimed in any preceding claim, and a corresponding male connector element, wherein the male connector element is provided with an insulating casing which allows it to be inserted in the female connector element and make electrical contact therewith, but prevents the inadvertent making of unwanted electrical contact when the male connector element is not so inserted.

8. An electrical terminal and a corresponding male connector element as claimed in claim 7, wherein the insulating casing is removable, retractable, or deformable to allow the male connector element to be inserted in the female connector element.

9. An electrically heated window provided with an electrical terminal as claimed in any one of claims 1 to 6.

10. An electrical terminal substantially as herein described with reference to and as illustrated in Figures 1 to 3 of the accompanying drawings.

11. An electrically heated window substantially as herein described with reference to and as illustrated in Figures 1 and 3 of the accompanying drawings.

12. A male electrical connector element substantially as herein described with reference to and as illustrated in any one of Figures 5, 6, 7 or 8 of the accompanying drawings.

10

Application No: GB 9930658.1
Claims searched: 1 - 11

Examiner: Paul Nicholls
Date of search: 2 May 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H2E (EEKE)

Int Cl (Ed.7): H01R 11/01, 13/115, 13/14; H05B 3/84

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1,588,107 A	(BENDIX) - See figure 4	1
X	EP 0,812,033 A2	(MOLEX) - See figure 1	1
X	EP 0,634,882 A2	(RICHARD HIRSCHMANN) - See figure 1	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.